

CBSIT 2009: Airborne Validation of Envisat Radar Altimetry and In Situ Ice Camp Measurements over Arctic Sea Ice

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The past few years have seen the emergence of satellite altimetry as a valuable tool for taking quantitative sea ice monitoring beyond the traditional surface extent measurements and into estimates of sea ice thickness and volume, parameters that are fundamental to improved understanding of polar dynamics and climate modeling. Several studies have now demonstrated the use of both microwave (ERS, Envisat/RA-2) and laser (ICESat/GLAS) satellite altimeters for determining sea ice thickness. The complexity of polar environments, however, continues to make sea ice thickness determination a complicated remote sensing task and validation studies remain essential for successful monitoring of sea ice by satellites. One such validation effort, the Arctic Aircraft Altimeter (AAA) campaign of 2006, included underflights of Envisat and ICESat north of the Canadian Archipelago using NASA's P-3 aircraft. This campaign compared Envisat and ICESat sea ice elevation measurements with high-resolution airborne elevation measurements, revealing the impact of refrozen leads on radar altimetry and ice drift on laser altimetry.

Continuing this research and validation effort, the Canada Basin Sea Ice Thickness (CBSIT) experiment was completed in April 2009. CBSIT was conducted by NOAA and NASA as part of NASA's Operation Ice Bridge, a gap-filling mission intended to supplement sea and land ice monitoring until the launch of NASA's ICESat-2 mission. CBSIT was flown on the NASA P-3, which was equipped with a scanning laser altimeter, a Ku-band snow radar, and an updated nadir looking photo-imaging system. The CBSIT campaign consisted of two flights: an underflight of Envisat along a 1000 km track similar to that flown in 2006, and a flight through the Nares Strait up to the Lincoln Sea that included an overflight of the Danish GreenArc Ice Camp off the coast of northern Greenland. We present an examination of data collected during this campaign, comparing airborne laser altimeter measurements with (1) Envisat RA-2 returns retracked optimally for sea ice and (2) in situ measurements of sea ice thickness and snow depth gathered from ice camp surveys. Particular attention is given to lead identification and classification using the continuous photo-imaging system along the Envisat underflight as well as the performance of the snow radar over the ice camp survey lines.